Model systems for the study of the chemical behavior of Element 104: 2. Extraction chromatography with tributyl phosphate

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In previous experiments the extraction of rutherfordium into TBP was studied using liquid-liquid extraction techniques. These techniques did not allow for direct determination of distribution coefficients. A different approach is to use a resin coated with organic extractant [1].

In batch experiments, 50 mg of 44% (w / w) TBP loaded Amberlite XAD-7 HP resin was contacted with hydrochloric acid solutions of varying concentrations containing tracer activities of ^{88}Zr and ^{181}Hf. After mixing and centrifuging the samples, an aliquot was taken from the aqueous phase and assayed using a Ge gamma-ray detector.

In column separation experiments, a 2-mm i. d. glass column was filled with 40 mg of the TBP loaded resin and conditioned with 12 M HCl. A stock solution containing ^{88}Zr and ^{181}Hf in 12 M HCl was loaded onto the column. The column was first washed with 300 µL of 7 M HCl and then with 300 of µL 1 M HCl. Fractions were collected and assayed.

Fig. 1 shows the amount of activity extracted by the resin as a function of hydrochloric acid concentration. The results are similar to the extraction behavior shown in liquid-liquid extraction experiments. Zirconium shows a higher tendency to extract than hafnium. At an acid concentration of 7 M, 51% of the zirconium activity is extracted by the resin, but only 20% of the hafnium activity.

In Fig. 2, the percentage of total activity eluted from the column is plotted against the amount of liquid that has passed through the column. Using 7 M hydrochloric acid about 85% of the total zirconium activity is eluted from the column in the first 14 free column volumes, but only 27% of the total hafnium activity is eluted. The remaining hafnium activity can be eluted from the column with 1 M hydrochloric acid. This shows that hafnium and zirconium can be separated using a chromatographic resin coated with tributyl phosphate. The procedure devised should be suitable for determining whether the extraction behavior of rutherfordium is similar to the behavior of zirconium or of hafnium.

Footnotes and References

1. R. Günther et al., Radiochim. Acta **80**, 121 (1998)

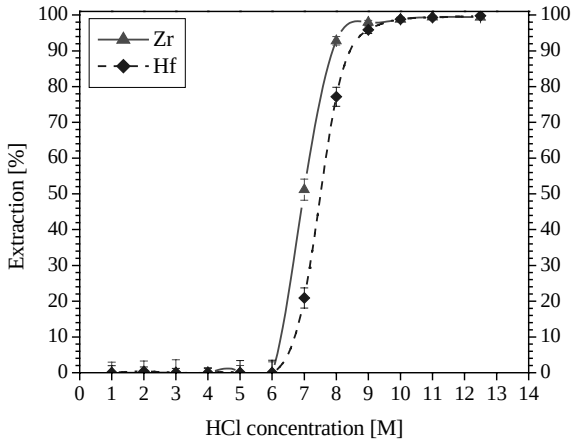

Fig. 1. Percent extraction of ^{88}Zr and ^{181}Hf from hydrochloric acid solutions on 44% (w / w) TBP loaded XAD-7 resin.

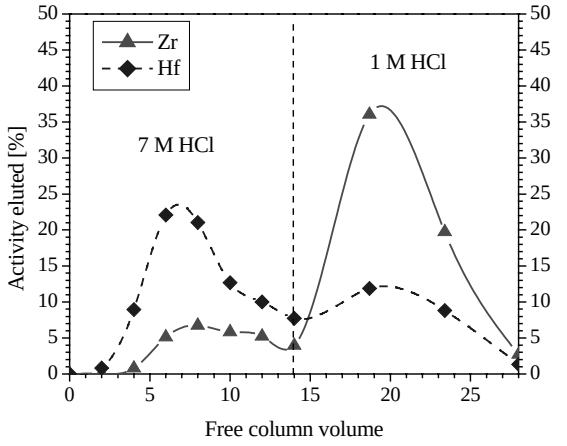

Fig. 2. Elution curves for ^{88}Zr and ^{181}Hf in 7 M and 1 M hydrochloric acid from a 2-mm i.d. column filled with 44% (w / w) TBP loaded XAD-7 resin.